

Introduction

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The State's precipitation varies significantly. California's mountain ranges influence the weather by lifting clouds and moisture. This increases precipitation on west-facing mountain slopes compared with the drier valley floor. Average annual precipitation on the North Coast mountains can be more than 100 inches while some areas in the southeastern part of the State receive less than 3 inches annually. Consequently, flooding in Northern California occurs more frequently.

The Sacramento Valley is especially vulnerable to flooding. In the mid-1800s, prior to the construction of the levees, the smallest floods would result in widespread inundation. The January 1847 flood is the earliest recorded flood in the San Joaquin Valley. Between 1850 and 1900, many floods occurred in the Sacramento and San Joaquin River basins. Among them are the December 1861 and January 1862 floods, which created a sea in the lower Sacramento River region and resulted in the City of Sacramento raising downtown and its levees. Other major flood events occurred in 1867, 1868, 1881, 1889, and 1890. Significant flood events in the 1900s

occurred in 1904, 1907, 1909, 1911, 1928, 1939, 1950, 1955, 1964, 1969, 1970, 1983, 1986, and 1995. The events in the early 1900s gave rise to flood control measures in the Sacramento and San Joaquin River systems. Folsom, Oroville, and Shasta dams further reduced the threat of flooding in the Sacramento River Basin.

California spans 159,000 square miles with a population of 32 million people. The northern part of the State receives about 75 percent of the precipitation, but more than two-thirds of the population live in the southern half of the State.

The Sacramento River system generates 32 percent of the State's annual runoff and is the major contributor to California's water supply. Estimated average annual precipitation in California is about 193 million acre-feet of which 122 million acre-feet is lost to evaporation and transpiration, leaving the remaining 71 million acre-feet as average annual runoff. Runoff ranges from 35 million acre-feet in drought years (1987–1992) to more than 130 million acre-feet (1995 runoff).



Overflow at Colusa Weir on March 11, 1995. The Colusa Basin is the flooded area in the background.

Table 1. Summary of Hydrology in Water Years 1987-1994

| Water Year | Statewide Precipitation (%) | April 1 Snowpack Water Content (%) | Water Year Runoff (%) | Sacramento River Unimpaired Runoff (maf) | September 30 Statewide Storage (maf) |
|------------|-----------------------------|------------------------------------|-----------------------|--|--------------------------------------|
| 1987 | 61 | 55 | 48 | 9.2 | 18.9 |
| 1988 | 80 | 30 | 48 | 9.2 | 14.8 |
| 1989 | 86 | 75 | 72 | 14.8 | 16.7 |
| 1990 | 69 | 40 | 45 | 9.2 | 13.6 |
| 1991 | 76 | 75 | 43 | 8.4 | 13.8 |
| 1992 | 85 | 60 | 43 | 8.9 | 12.7 |
| 1993 | 140 | 150 | 125 | 22.2 | 24.0 |
| 1994 | 65 | 50 | 40 | 7.8 | 15.9 |

maf = million acre-feet

After the 1986 floods California had six years of drought. The drought ended with heavy precipitation in the winter of 1993. The following is a summary of each water year between 1986 and 1995 (Table 1).

1 ■ Water Year 1987: October 1986 through September 1987

This was the first year of the six-year drought. The eastern slope of the Sierra was the driest portion of the State while the southeastern desert and far North Coast regions were the wettest on a percent-of-average basis. No region, however, received average amounts of precipitation. Year-end statewide totals were 61 percent of average precipitation, 48 percent of average runoff, and 80 percent of average reservoir storage.

1 ■ Water Year 1988: October 1987 through September 1988

This was the second year of below-average rainfall and snow water content. After a dry start December had significantly above-average precipitation in Northern California and would remain the wettest month of the water year. Although below average, January amounts were sufficient to relieve drought concerns, but February and March were dry with runoff less than 50 percent of average. The San Francisco

Bay and Central Coast hydrologic regions were particularly dry with runoff at about 30 percent of average. Year-end statewide totals were slightly above 80 percent of average precipitation, 48 percent of average runoff, and about 67 percent of average reservoir storage.

■ Water Year 1989: October 1988 through September 1989

Water year 1989 was wetter than the preceding two years but still considerably below average. Three northern hydrologic regions—North Coast, Sacramento River, and San Francisco Bay—received average rainfall, but the Central and South Coast regions received about 65 percent of average. By late summer more than 10 million Californians were practicing water conservation, and by August five counties had declared drought emergencies. Year-end statewide totals were 86 percent of average precipitation, 72 percent of average runoff, and 74 percent of average reservoir storage.

■ Water Year 1990: October 1989 through September 1990

The fourth year of drought had numerous negative impacts to the State, and the federal Central Valley Project and the State Water Project reduced water deliveries for only the second time in their histories. Snow water

Looking south toward downtown Sacramento with Discovery Park and the American River in the foreground. The Sacramento River is on the top right.



content peaked on March 1, a month earlier than normal. All regions had below-average snowpack throughout the year and conditions similar to those of the drought year of 1976 until May, which was a wet month. In comparison, statewide snow water content on May 1, 1976, was 35 percent of average; but on May 1, 1990, it was just 10 percent of normal. Year-end statewide totals were 69 percent of average precipitation, about 45 percent of average runoff, and 60 percent of average reservoir storage.

■ **Water Year 1991: October 1990 through September 1991**

The fifth year of drought continued generally dry until the “miracle” month of March, when statewide precipitation was nearly three times the average. More than 18 inches of rain raised the seasonal total from about 35 to 75 percent of average. Totals were highest in the southern half of the State and somewhat less than the overall average in the Northern California watersheds that generate a majority of the State’s runoff. The statewide snow

water content increased from about 15 to 75 percent of average during March. Year-end statewide totals were 76 percent of average precipitation, 43 percent of average runoff, and 56 percent of average for reservoir storage. The Sacramento River Index for the year was 8.4 million acre-feet, a “critically dry” year when compared to the 18.1 million acre-feet average.

■ **Water Year 1992: October 1991 through September 1992**

In this sixth consecutive drought year, snow water content reached 70 percent of average on March 1 but declined to 60 percent of average by April 1. The South Coast was the only hydrologic region with above-average runoff, the result of heavy rains in February and March. Year-end statewide totals were about 85 percent of average precipitation, 43 percent of average runoff, and 56 percent of average reservoir storage. The Sacramento River Index was 8.9 million acre-feet for the year, the third critically dry year in succession.

■ Water Year 1993: October 1992 through September 1993

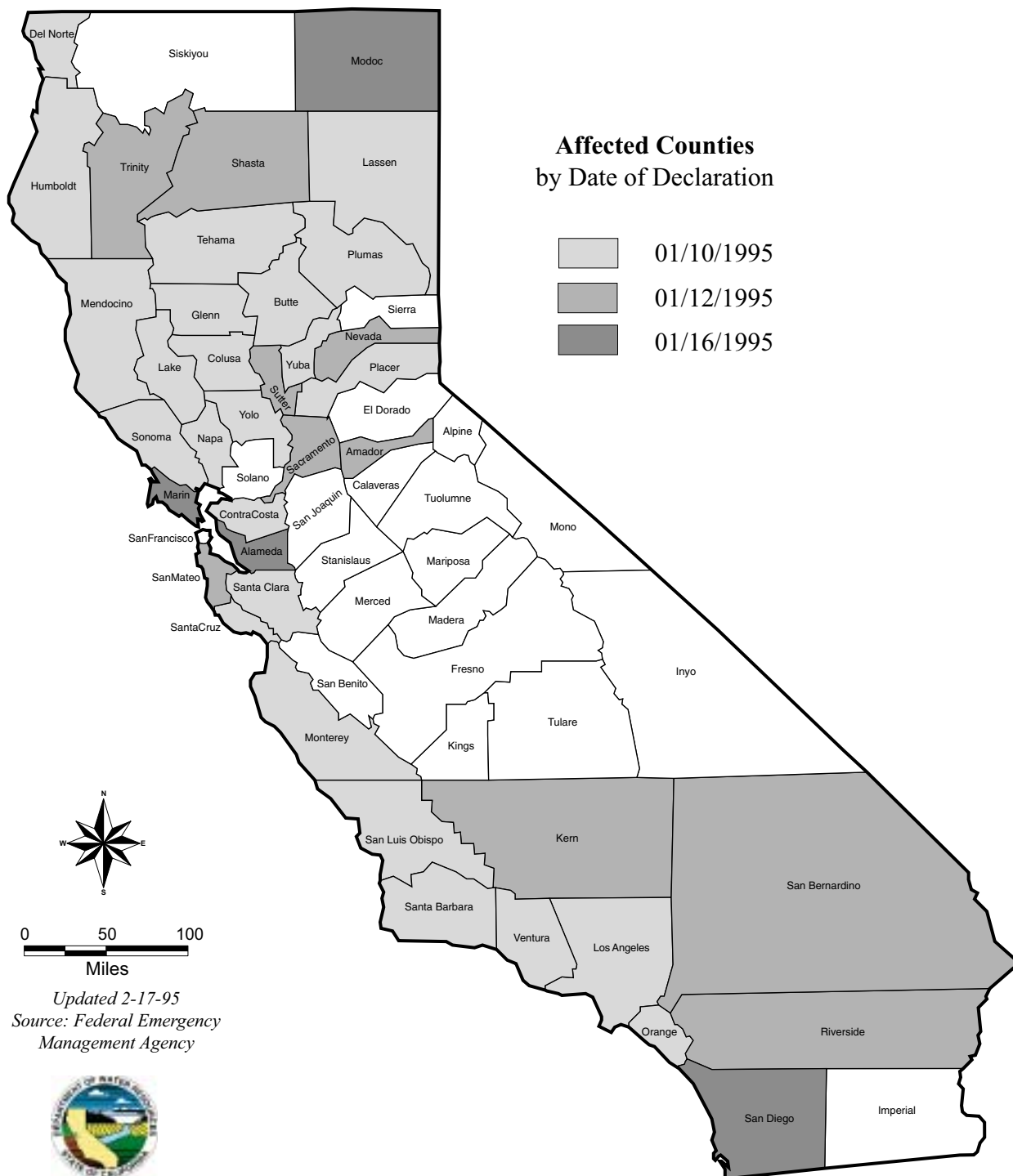
Water year 1993 broke the six-year drought—the third and most severe drought of the century in Northern California. (The century's longest drought occurred from 1928 to 1935.) By April 1 statewide snow water content averaged about 150 percent of normal, with the San Joaquin River Hydrologic Region the highest at 165 percent of average and the North Coast Hydrologic Region the lowest at 110 percent. Year-end statewide totals were about 140 percent of average precipitation, 125 percent of average runoff, and about 110 percent of average reservoir storage. Lake Tahoe, Lake Berryessa, and New Melones Reservoir were the only large lakes that did not fully recover. The Sacramento River Index rose to 22.2 million acre-feet, soundly breaking the three-year period of critically dry years.

■ Water Year 1994: October 1993 through September 1994

California's water situation took a turn for the worse, and there were fears that the drought might resume. March was one of the driest on record in Northern California, and as of April 1 statewide seasonal runoff stood at about 40 percent of average compared to 110 percent in 1993. Snow water content stood at 50 percent of average compared to 150 percent in 1993. Year-end statewide totals were 65 percent of average precipitation, 40 percent of average runoff, and 73 percent of average reservoir storage.

Widespread flooding over much of California's hydrologic basins occurred during the January and March storms of 1995. These floods affected thousands of people and resulted in significant property damage, environmental degradation, and loss of life. Damages for the January 1995 event totaled about \$120 million and for the March 1995, about \$101 million. Forty-two counties in January and fifty-seven counties in March were declared State and federal disaster areas (figures 1 and 2).

**Figure 1. Counties Declared by Federal Government as Flood Disaster Areas,
January 1995**



**Figure 2. Counties Declared by Federal Government as Flood Disaster Areas,
March 1995**



**Source: Federal Emergency
Management Agency**